EXHIBIT 5

Historical Review:

In January 1964, Dotter performed the first successful percutaneous transluminal angioplasty (PTA) using progressive luminal dilatation by means of a system of coaxial catheters (1). The method had little acceptance in the U.S. but gained interest among several investigators in Europe. At an international congress devoted to PTA 1800 cases were presented from twelve groups of authors. Portsman (2) first reported, in 1973, the use of a balloon catheter to dilate arterial stenosis. A modified version of this balloon, the so-called caged balloon, was described by Dotter and manufactured by Cook, Inc., Bloomington, Indiana. 47 401. Gruntzdig and Hopff (3) introduced an angioplasty balloon catheter able to accept relatively high pressures without loosing the balloon shape. The balloon is made of polyvinyl chloride and is smoothly tapered at both ends.

Technique and Applications:

Gruntzdig balloon catheters are manufactured in several balloon lengths and diameters (4). Effective dilatation pressure varies between 3-5 atm P, and can be obtained with single 2 cc plastic syringe using diluted contrast material or with specially manufactured pumps which deliver measured amounts of CO_2 under positive and negative pressures for quick inflation and deflation. Total obstructions may be recanalized by first traversing the lesion carefully with a "J" tip teflon coated movable core guide wire. Some authors recommend the use of Aspirin or Persantine 48 or 72 hours prior to PTA. Once the catheter is in place 5000 IU of heparine are injected in the arterial lumen. In addition Gruntzdig recommends the IA injection of Priscoline

or ATP prior to PTA to increase peripheral flow. The balloon is expanded up to four times as needed, during 30 to 60 seconds. Contrast injections are made between dilatations to evaluate the results under fluoroscopy. Pressures are recorded proximal and distal to the stenosis in iliac and superficial femoral dilatations. In femoral and popliteal lesions the flow changes are better monitored by Doppler measurements. (5)

The prime indication for dilatation is a relatively short segment of stenosis in a medium size artery (6). Both the axillary and femoral approaches are feasible. Renal, (7,8) coronary and vertibral artery stenoses have been treated successfully. Total occlusion recanalization is attempted in the superficial femoral artery if the occluded segment is 10 cm or shorter (1,4). No recanalization should be attempted in iliac obstructions because in case of perforation of the vessel wall the ensuing hemorrhage is defficult to control (4).

Contraindications to PTA (6) are a) stenosis at the point of origin of an essential or principal collateral. b) Segment of occlusion larger than 10 cm, c) Intraluminal calcification. d) Multiple stenosis of the superficial and deep femoral arteries without an elaborate collateral system. e) stenosis at a single remaining artery below the knee. Combined PTA with surgical treatment is indicated in patients with localized iliac stenosis and obstruction of long segments of superficial femoral artery. The dilatation of the proximal lesion would support the effectiveness of a femoropopliteal bypass (6).

Reported Results:

Dotter estimates that over 15,000 percutaneous transluminal angioplasties have been performed so far. (9) The same author considers that in about 80-90% of properly selected cases there is immediate relief after a procedure which entails no more risk than the angiographic study usually required prior to surgery. Gruntzdig has treated over 300 patients since 1971 (4). He had an initial success rate of 84% for recanalization of femoro-popliteal occlusions and 92% for iliac artery stenosis. In his hands the two year patency rate is 72% for successfully treated femoropopliteal lesions and 87% for iliac artery stenosis.

Complications inherent to the procedure include subintimal hemorrhage and thrombosis, distal embolization and rupture of the wall. Circumferential balloon tears may prevent withdrawal of the catheter and require surgery.

Failure in performing successful dilatation happens in 10-20% of the times. Failure is not considered a complication by most authors, provided that there is not a post-procedure change that makes the patient's circulatory status worse. Nevertheless, this criterion must be used rather flexibly by some authors in view of the low complication rate reported. The complication rate varies from 5 to 7% (4,5) . For some investigators small distal embolization is insignificant if it is not clinically apparent. (10).

Histopathologic Changes in PTA:

Since the introduction of the method by Dotter and Judkins (1), the basic mechanism of angioplasty has been thought to be compression and redistribution of the atheromatous material against the vessel wall. Recently Castaneda-Zuniga, et al (11) have demonstrated that the atheromatous material is incompressible and that the increase in the arterial lumen obtained by PTA is due to stretching of the arterial wall. Microscopic examination of dilated arteries showed fragmented intima and compaction and stretching of elastic fibers with loss of undulation. The nuclei of the smooth muscle cells adopt a peculiar corkscrew appearance. By dilating isolated arteries of cadavers these authors observed that the vessels stretched and then resumed their original size as soon as the balloon was deflated, probably due to lack of blood pressure. Nevertheless, beyond certain degree of circumferential widening the arterial wall stretching was irreversible. The non-elastic atheromatous material undergoes fissuring and separation from the stretched elastic base being therefore prone to become dislodged. Further stretching of the vessel wall results in rupture of all layers.

On the basis of the explained mechanism the balloon has to produce enough circumferential dilatation as to surpass the elastic property of the vessel wall producing an aneurysmal deformity to accomodate the fractured atheromatous material so as to maintain a lumen uniform with the adjacent normal artery. Although the practice has proven that 3-5 atm P is adequate to obtain satisfactory dilatation it is not difficult to conceive that it would not be possible to safely establish which pressure

is adequate to each case. If the pressure is too low, no change is produced. If the pressure is too high distension of the vessel wall may reach the point of rupture. The limits between these two extremes may be rather narrow in certain situations of severe degenerative changes and calcification.

Proposed alternative to balloon dilatation:

The fractured atheromatous material may be contained against the vessel wall by placing an intraluminal tubular structure which may be expanded at one time with the stenotic lesion. The tube should be mounted on the balloon and introduced in the artery with it. Once it is in place the balloon insuflation would expand the tube and the stenotic lesion together. The tube should have memory properties so as to oppose the elastic recoil of the wall. The tube would at the same time, maintain the lumen, avoid dislodgment of atheromatous material and give structural support to the wall. Theoretical drawbacks include:

a) Reduction of the longitudinal flexibility of the artery.

b) Thrombogenicity of the prosthetic material.

c) Migration from the point of placement. Limiting the length of the tube to short segments less than 4 cm may be a solution to the first problem. The make of the tube has to be related to the modern non-thrombogenic vascular prosthetic materials. Displacement of the tube from its insertion point may be prevented by giving the tube either a fenestrated or a corrugated external surface. The memory of the tube may be obtained by an inner deformable wire mesh consisting in crisscrossed structure with welded crossing points.

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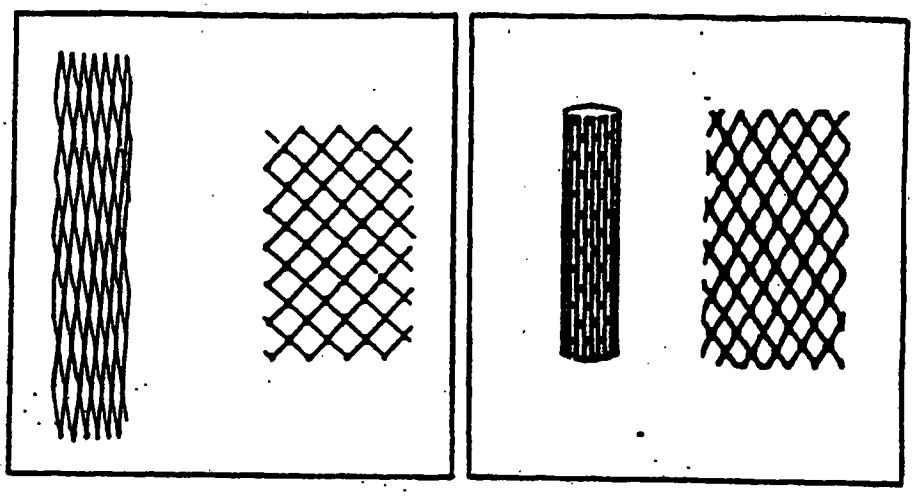
(Figure 1.)



This mesh should be made of silver, tantalum or stainless steel. Several wire diameters have to be experimented in each wire material so as to establish the optimum point between resistance to deformity and ability to retain the shape. The wire mesh is then covered with the vascular prosthetic material which has to have low thrombogenicity and high radial compliance. Porous polyurethane may prove suitable for this use. The material should cover the mesh inside and outside. The outer surface may contain multiple circumferential protuberances to assure anchorage to the vessel. Probably, multiple orifices or localized depresions on the outer surface may provide the same stability without the need of increasing the total tube wall thickness.(Figure 2.)

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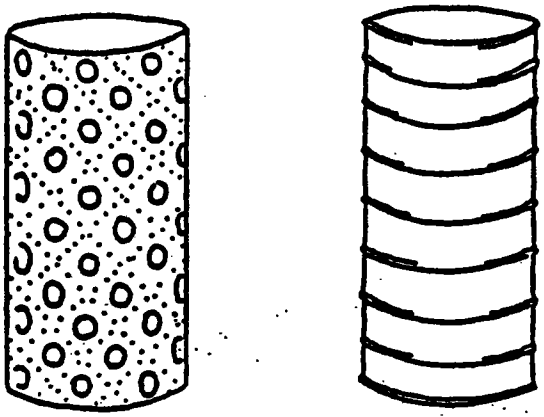
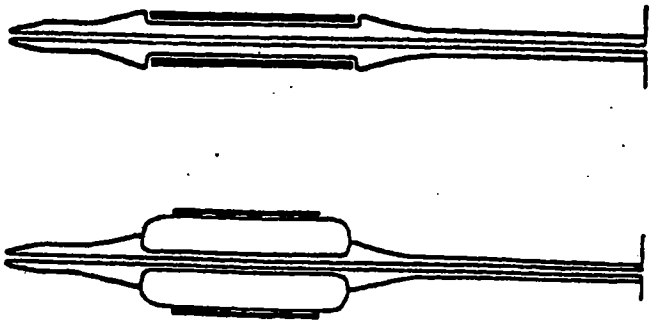


The tube should be mounted in the collapsed state over a modified Grünzdig balloon catheter of adequate length and diameter. The leading and trailing extremes of the balloon have to be oversized so as to accommodate the tube over the balloon without protruding edges. (Figure 3)



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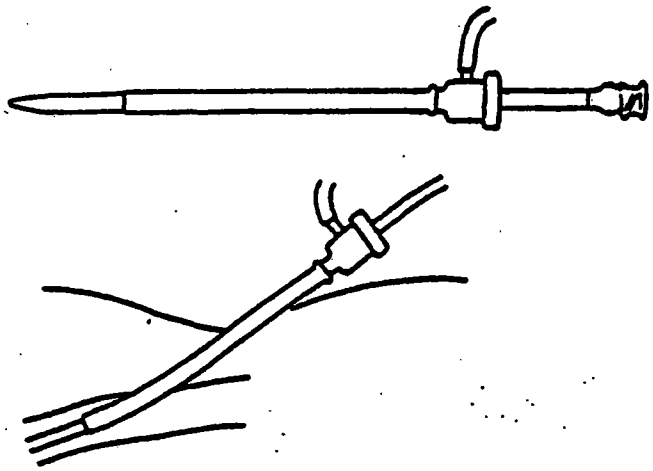
The whole system may be introduced in the femoral artery through an introducer sheath already in place. (Figure 4.)



The assembly is advanced through a wire which tip is beyond the area to be dilated.

The experimental project might be developed in three stages:

a.) Experimentation of different wire structures by changing mesh density, wire diatmeter and wire material to establish adequate dilating pressures, resistance to expansion and memory of the mesh.

b.) Placement of the tube in isolated cadaver arteries with stenotic arteriosclerotic lesions.

c.) Placement of the tube by percutaneous insertion into femoral arteries of laboratory 50 pound mongrel dogs, sheep or swine, in whom previous operative artificial iliac stenosis have been performed. The control of the tube patency is done by an adequately tailored schedule of aortograms performed by contralateral femoral catheterization. The animals are sacrificed at suitable intervals of time and gross and histopathological examination of the artery and tube is done.

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EXHIBIT 6

RESEARCH PROJECT

EXPANDABLE VASCULAR ENDOPROSTHESIS

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Introduction:

All forms of intraluminal dilatation of stenotic lesions involve shearing and disruption of the wall components to achieve a wider lumen. In the case of arterial atherosclerotic lesions, the relatively incompressible plaque remains unaltered while the more elastic medial and adventitial layers stretch around the plaque. This phenomenon produces splitting of the wall layers usually at the level of the internal elastic lamina resulting in a partially detached plaque. The intima suffers fissuring and ther may be loss of underlying amorphous material into the lumen (1). Fortunately, the distending intraluminal pressure seems to hold the disrupted layers in place and thrombus deposition prevent significant embolization.

Dilatation of lesions composed by actively proliferating tissue such as neointimal hyperplasia in the case of vascular anastomotic stenosis and neoplastic tissue such as in esophageal, ureteral, bronchial and biliary malignant strictures is doomed to early restenoses if initially good results have been obtained. Sometimes, adequate dilatation is not achieved initially despite multiple dilatation attempts and the trial of different balloon configurations. Atherosclerotic lesions do not have the same mechanical characteristics throughout the arterial tree in relationship to their response to balloon dilatation. For example, it is now well known that plaques at the ostium of the renal arteries encompassing the adjacent aortic wall are unyielding to dilatation (2). Treatment of these lesions by balloon angioplasty have proven to be far less successful than distal renal atherosclerotic dilatations (2). The gross characteristics of the plaques involving the orifices of the celiac and mesenteric orifices is different from those involving the infrarenal aorta and iliac arteries. The former are edematous looking more elastic and do not contain a relatively high proportion of cholesterol and

calcium (3). These features may explain some of the failed attempts of dilatation of proximal celiac and mesenteric stenoses. Carotid and vertebral artery atherosclerotic stenosis dilatation is theoretically contraindicated because of the inherent risk of embolic events. Nevertheless a number of vertebral dilatations have been reported without complications (4). Subclavian, innominate, common carotid and vertebral stenoses are relatively common in symptomatic patients in whom no surgery is warranted for a variety of reasons. These patients are potential candidates for angioplasty if the lesions to be dilated show no ulceration. Unfortunately the angiographic evidence of absence of ulceration is frequently false due to thrombi covering the ulcer. Even in case of absent ulceration, dilatation of plaques rich in calcium and cholesterol may produce emboli dangerous in the cerebral circulation while the same phenomenon is usuall clinically undetected in the lower extremities.

Recanalization of iliac lesions has been shown to be associated with a high incidence of significant embolization (5) probably due to the large amount of thrombotic and atherosclerotic material to be mobilized. Long segment superficial femoral artery recanalization has also poor results for the same reason and the lower flow rate in that vessel.

Venous access fistulas for hemodyalisis with anastomotic or post anastomotic stenosis have been treated with balloon dilatation (6). Nevertheless these lesions have been noted to be harder to dilate and have required balloon diameters larger than originally thought. Takayasu's arteritis and neurofibromatosis vascular stenoses have been treated by balloon angioplasty with variable results. In some patients early restenoses required repeated dilatations (7).

In summary, each failure of balloon dilatation is usually due to elastic recoil of highly fibrous lesions. In general recurrent stenosis is due to

actively proliferating tissue. The risk of embolization is insignificant in certain vascular territories but clearly precludes the use of angioplasty in others.

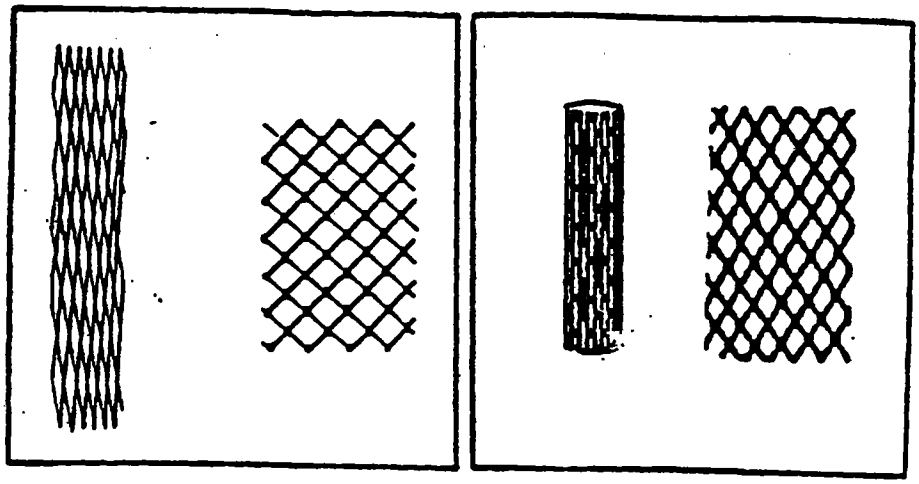
Endoluminal expandable prosthesis:

The idea of percutaneous placement of an endoluminal graft was first used by Dotter in 1969 (8). This author placed metallic coils inside of femoral arteries of dogs and showed long term patency. More recently the same author and others (9-10) have used metallic coils made of a heat sensitive alloy that allowed the coil to expand in place after percutaneous introduction. These authors also mentioned the potential application of this method in territories other than the vascular. Nevertheless, the biocompatibility and mechanical aspects of this material as well as cost considerations will need extensive and prolonged testing. One theoretical drawback of this method would be the lack of control on the reshaping of the coil after deposition. Excessive or insufficient pressure of the coil on the arterial wall may prove inadequate for lumen restoration particularly when a wide variety of stenotic shapes and wall compliances are considered. For the same reason, compactness of the coil may not be adequate in unyielding lesions and the possibility of perforation has to be considered. Finally if the coil reshapes in inadequate position occlusion of the tubular structure may ensue.

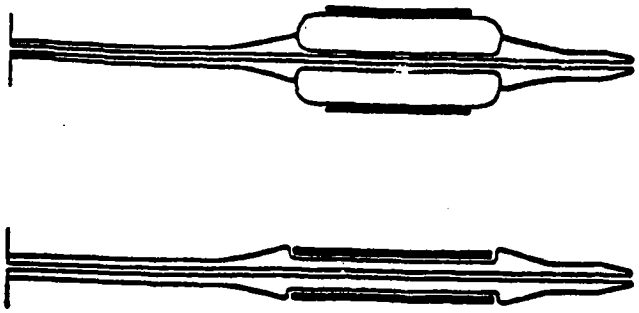
Proposed endoluminal prosthesis:

An expandable tube introduced percutaneously, mounted on a modified angioplasty balloon catheter will have the possibility of being delivered in place while the stenosis is being dilated. The tube would maintain the lumen, avoid dislodgement of loose material and give structural support to the wall.

The degree of expansion of the tube can be monitored both by pressure and fluoroscopy in the same way angioplasty is done. The prosthetic tube wall should be adequately thin so as to avoid reducing the lumen of the tubular structure to be dilated by excessively increasing the total wall thickness. Two theoretical general configurations based on the same principle have been devised: a tubular wire mesh similar to the popular toy "Chinese fingers" and an expandable metal tube with longitudinal fissures.



The first configuration could be fabricated out of silver, tantalum or stainless steel wire. Several wire diameters have to be tried to establish the optimum point between resistance to deformity and ability to retain shape. The cross points of the helical and antihelical wire coils should be welded in the expanded state and then the tube should be coated with teflon and heparin using the standard methods employed for vascular guide wires manufacturing. The tube should be compressed, mounted over a modified balloon angioplasty catheter with guards to protect the graft leading and trailing ends while the assembly is advanced within the skin.

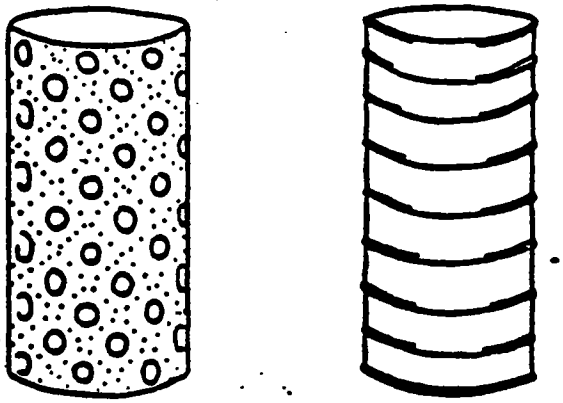


Once in place inflation of the balloon will expand the tube and the vessel or duct together. The spaces between wires will be occupied by extruded material providing anchorage to the graft. Shortening of the tube as it is being dilated will occur and it will be exponentially related to the degree of dilatation.

The second configuration is basically similar. The tube could initially be a thin walled silver, tantalum or stainless steel continuous tube in which alternating fissures such as shown in Fig. 1 have been done. This process may require sophisticated techniques such as electronic or laser etching. After expansion, the unfolded "bars" between fissures will twist and loss of length will result. Although the expanded tube wall will be thicker than the wire mesh tube the unexpanded tube wall will be smoother and thinner therefore allowing an easier introduction and positioning before inflation.

After testing either or both configurations for mechanical behavior, stability and biocompatibility a second phase of development should involve coating of the tubes with porous polyurethane or other biologically inert plastic. The plast coat should be thin and highly compliant so as not to interfere with mechanics of the tube. The tube could be coated in a continuous

fashion and the external surface could have ridges or knobs for peripheral anchoring. This configuration could be particularly adequate for non vascular ducts. The coating of the wire mesh tube could be done so as to leave holes or spaces between the wires, therefore allowing the inner surface of the dilated structure to be partially in direct contact with the lumen contents.



Theoretical drawbacks include:

a) Reduction of the longitudinal flexibility of the artery or duct.

b) Low or absent radial compliance of the graft.

c) Possibility of migration of the graft.

In the vascular system the tube lengths should be limited to probably no more than 4 cm. Longer areas of stenosis or occlusion could be dealt with tubes in tandem. Nevertheless the tube will be collapsible and probably inadequate for use in mobile areas such as the common femoral artery. A metal tube will have little or no radial compliance. Mismatch of radial compliance at the point of transition between host tissue and graft is of critical significance in the arterial system. Nevertheless highly sclerotic and calcified arteries have a substantial loss of radial compliance therefore the mismatch may be minimal or

nonsignificant. These considerations are even less critical in other organic tubular structures particularly when they are involved by neoplasms. Measures to prevent graft migration have been discussed above. The wire mesh tube without an extruded plastic coating on top will probably be very stable. The mesh will be "embedded" in the wall by pressure and the tissue surface between wires will most likely repithelialize covering the mesh completely.

Significance of the problem:

Although angioplasty has had a great expansion in its use and indications in the past 10 years, in many cases, it will prove inadequate as a long term solution for many applications. Nevertheless the impact on medical care costs is obvious and the savings in hospitalization time and patient suffering has been repeatedly proven. The latter is particularly significant in the older population with advance disease and limited survival time. In the terminal cancer patient, when neoplasms involve tubular structures, their patency usually will determine the length of survival. This is true in the urinary, biliary and respiratory tracts as well as in the esophagus and aqueduct. Large amounts of money, equipment and human resources are devoted to prolong the life of the elder and the cancer patient. If new methods to alleviate symptoms and palliate incurable disease can achieve these objectives at a lower medical cost, they deserve intensive research and development efforts.

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EXHIBIT 7

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF DELAWARE

ADVANCED CARDIOVASCULAR SYSTEMS, INC. and GUIDANT SALES CORP.,	)	
Plaintiffs,	)	
v.	)	Civ. No. 98-80-SLR (Lead Case)
MEDTRONIC VASCULAR, INC. and MEDTRONIC USA, INC,	)	Consolidated with Civ. No. 98-314-SLR
Defendants.	)	Civ. No. 98-316-SLR

O R D E R

At Wilmington this 9th day of August, 2005, having reviewed the parties' submissions regarding trial of damages and willfulness;

IT IS ORDERED that the stay imposed on the trial of these issues shall continue in place until further order of the court, given the complexity of the market in light of the extensive litigation between the primary market players.

United States District Judge

EXHIBIT 8

FULLY REDACTED

EXHIBIT 9

22

Janis Joplin's yearbook and the theory of damages (1990)

Introduction: Making the plaintiff whole

The trial on liability is over, and the plaintiff has won. Now the question of the amount of damages arises. There is more than one standard that can be used here. For example, one might award damages to punish the defendant or to deter other prospective offenders. A commonly used standard in civil cases, however, is that of making the plaintiff 'whole' in the sense of exact compensation – placing him, her or it in the position that would have been occupied had the violation not taken place. Even where additional damages are to be awarded (trebling in antitrust cases, for example, or punitive damages generally), the trier of fact is often called upon to calculate the amount of compensatory damages.

Some questions arise as to how this should be done – questions not only difficult in practice but interesting in principle. Most (not all) of these stem from the fact that trials take time, so the damage award will be made long after the violation that caused the damages. In particular, to what extent should the defendant be compensated for the time value of money between the injury and the award?[1] In deciding on the award, should the trier of fact use the benefit of hindsight? This chapter considers these and related issues.[2]

[1] Written jointly with R. Craig Romaine. While this chapter is largely based on work done over the last few years, the occasion for writing it came when I was invited to a conference to discuss the paper by R.F. Lanzillotti and A.K. Esquibel, 'Measuring damages in commercial litigation: present value of lost opportunities', (Lanzillotti and Esquibel 1990). The present chapter evolved in part from that discussion. I am grateful for the invitation and hope to be forgiven for producing a related article rather than a discussion as such.

The rate of prejudgment interest[3]

We begin with a simple case. The violation took place at a single point of time, time 0. It involved the destruction of an asset whose value at that time is clearly known as Y. Hence, had damages been assessed at time 0, an award of Y would have made the plaintiff whole. Unfortunately, however, the processes of justice take time, and the award is to be made at time $t > 0$. How (if at all) should the plaintiff be compensated for this fact?

At first glance, it may seem that the plaintiff is entitled to interest at its opportunity cost of capital, r. After all, had the plaintiff received Y at time 0, it would have invested the funds, receiving presumably its average rate of return. Hence, by time t, the plaintiff would have had Ye^{rt}, so this is the amount that would make it whole. Another version of this argument would compensate the plaintiff at the rate it reasonably expected to earn on the destroyed asset.

The fallacy here (in either version) has to do with risk. The plaintiff's opportunity cost of capital includes a return that compensates the plaintiff for the average risk it bears. But, in depriving the plaintiff of an asset worth Y at time 0, the defendant also relieved it of the risks associated with investment in that asset. The plaintiff is thus entitled to interest compensating it for the time value of money, but is not also entitled to compensation for the risks it did not bear. Hence prejudgment interest should be awarded at the risk-free interest rate, $r^* < r$.

One can see the problem with awarding interest at the plaintiff's opportunity cost of capital by considering the following example. The same defendant destroys two identical assets belonging to two different plaintiffs, Hetty and Ravenal. Hetty is extremely risk-averse and only invests in government bonds. Ravenal, on the other hand, invests in high-risk ventures. On average, Hetty earns a low rate of return, while Ravenal earns a high one. Naturally, those returns have different distributions: Hetty always earns the same rate on every investment, while Ravenal earns a very high rate on a few investments and loses money on most others.

In this situation, it cannot be right to award Ravenal a higher amount than Hetty just because of the passage of time and their different investment strategies. Had the award been made at time 0, they would each have been awarded the same amount. To give Ravenal more than Hetty

at time t is to forget that his higher average rate of return compensates him for the risk associated with his investments. It is made up of even higher returns on successful ventures and negative returns on unsuccessful ones. The asset destroyed might perfectly well have been employed in an unsuccessful venture; that risk has not been borne.[4]

To vary the example, suppose that Hetty is a prudent investor, while Ravenal is a (very rich) compulsive gambler who always loses and would, by time t, have frittered away the asset. It cannot be right to award Hetty positive interest and award Ravenal nothing at all. In this case, Ravenal's negative returns are the price he pays for indulging his tastes for hopeless risk. He was surely not able to indulge those tastes with the asset in question; hence, he should not have to pay the price. The same general principle applies to less extreme examples with positive returns: the plaintiff should not be compensated (positively or negatively) for risks he or she did not bear.

The paper by Patell *et al.* (1982) agrees with this principle but reaches a different conclusion. It points out that the defendant's actions did not relieve the plaintiff of all risk. Even assuming that the outcome of the trial was certain, the plaintiff bore the risk that the defendant would go bankrupt before paying the damage award. Therefore, the authors argue, the plaintiff is entitled to interest that reflects that risk, interest at the rate paid by the defendant on its own bonds.

This position raises two problems. First, even corporations cannot borrow unlimited amounts at fixed rates.[5] If the value of the asset destroyed was beyond the ability of the defendant to borrow, it is not clear what should be done if one adopts the principle of Patell *et al.*

More fundamental than this is the second problem. The risk of the defendant's bankruptcy is not the only risk the plaintiff bears. It also bears the risk of losing the case. Moreover, the plaintiff has borne the expense of litigation. Truly to place the plaintiff in the same position as if the violation had not occurred would involve recompensing for all litigation risks and costs. In the US system, however, this is not usually done. We choose to distribute the risks and costs of litigation differently than do some foreign countries. But the risk that the defendant will go bankrupt during trial is properly associated with the risks of litigation, not with the violation itself. It is hard to see why that risk should be singled out as one for which the plaintiff is to be compensated. Accordingly, we retain the position that prejudgment interest should be awarded at the risk-free rate.

The treatment of taxes

It is important to realize, however, that the appropriate risk-free rate to use must take account of tax effects, as must the entire damage calculation. Making the plaintiff whole must mean making them whole after taxes, remembering that the damage award is taxable[6] as would have been lost profits and the interest earned thereon. (Naturally, one must account for the possibility that no taxes would in fact have been due.)

The simplest case to handle (and the only one to which we shall give explicit treatment) is that in which the effective tax rate paid by the plaintiff would not have been affected had the award been made in year 0 and will not be affected by the payment of the award in year t. (More complex cases do not present any interesting new matters of principle.)

For $0 \leqslant i \leqslant t$, let θ_i be the effective tax rate in year i, and r_i^* be the before-tax risk-free rate (the rate on treasury bills, say) in that year. Had the award of Y been made in year 0 (coinciding with the damage itself), the plaintiff would have paid taxes on it, invested the remainder at the risk-free rate, r_i^*, and paid taxes on the resulting earnings. The net after-tax interest that would have been retained would therefore have been at the after-tax risk-free rate, which we denote by $\hat{r}_i^*$ where:

$$\hat{r}_i^* \equiv r_i^*(1 - \theta_i) \tag{22.1}$$

Let

$$\hat{Y} \equiv Y(1 - \theta_0) \tag{22.2}$$

be the after-tax dollars that would have been retained by the plaintiff in year 0 had the award been made then. Evidently, the plaintiff's net after-tax position would be in year t:

$$\hat{S} = Y(1 - \theta_0) \prod_{i=0}^{t} (1 + \hat{r}_i^*) \tag{22.3}$$

The before-tax award that results in this after-tax amount is

$$S = \hat{S}/(1 - \theta_t) \tag{22.4}$$

Note that if the effective tax rate is the same at times 0 and t, then, when Equation 22.2 is substituted into Equations 22.3 and 22.4, the term in $(1 - \theta_0)$ will be cancelled by the division in Equation 22.4. Nevertheless, this does not mean that there are no tax effects. The result in that case is equivalent to allowing the before-tax loss of Y to accumulate interest at the after-tax risk-free rate, $\hat{r}_i^*$.

Discounting the stream of lost profits

So far, we have assumed that the damage-producing act consists of the destruction of an asset of known value, Y. In practice, this is not likely to be the case. Rather it is very often the case that the violation

removed the opportunity to earn a stream of profits. In the recently concluded *ETSI* case[7], for example, plaintiffs claimed that the actions of the defendant railroads had prevented them from building a pipeline with which to transport coal in slurry form from Wyoming to the Southwest. Damages were claimed for the lost stream of profits that the pipeline would have earned.

As this example illustrates, there is no difference in principle between a claim for a stream of lost profits and a claim for the destruction of an asset. An asset is in fact worth the present value of the profit stream associated with it; to turn the matter around, the possession of a profit stream is the possession of an asset worth the present value of that stream. Hence our previous treatment applies to such cases.

To stop here, however, would be to overlook some subsidiary matters of vital practical importance. How is one to determine the profit stream to be discounted? Further, what discount rate should be used in doing the discounting? These questions are related, but we begin by focusing on the latter question.

If we consider the loss of a profit stream that would have started at time 0 to be the same as the loss of an asset at time 0, then we must begin by valuing the asset as of that time. The fact that the award will be made at time $t > 0$ can than be taken into account as already discussed.

Accordingly, having decided on an expected profit stream as seen from time zero (this is discussed below), we must discount that stream, not with a risk-free rate, but with a discount rate that includes a risk premium suitable to the risks involved. If the venture that was injured was similar to others undertaken by the plaintiff, then the plaintiff's correctly measured cost of capital as of the time of violation will be the appropriate rate to use here.[8] Otherwise, a different measure will be needed.

Maintaining the same tax assumptions and notation as before, let M_i denote the value of the before-tax lost profits that would have been earned in year i. Let r denote the value of the appropriate discount rate to be used in discounting after-tax cash flows. (Note that both the discount rate and the tax rate are taken as of time 0 to reflect the plaintiff's reasonable expectations as of that date. The issues involved in doing this are discussed below.)

The difference between this case and that already considered lies in the fact that the term $\hat{Y}$ in Equation 22.3 will not be given by Equation 22.2 with Y known, but rather by:

$$\hat{Y} = \sum_{i=0}^{\infty} M_i(1 - \theta_0)\,[1/(1 + r)]^i \qquad (22.5)^9$$

Note the major implication here. Lost profits for year i (the difference between 'but-for' and actual profits in year i) are not considered to be awarded as of year i and then allowed to accumulate interest. Rather, they are first discounted back to the date of violation, year 0, using a risk-adjusted post-tax discount rate. They then accumulate interest at the *risk-free* post-tax rate from year 0 to year t when the award is made.

Since the risk-adjusted rate will generally be considerably higher than the risk-free rate, this difference in treatment can amount to a very substantial difference in result, with the difference becoming larger the longer the damage award is delayed. In the *ETSI* case, for example, the plaintiff offered a calculation for a damage award to be made in 1988 (contingent on a finding of liability) as compensation for an injury suffered in 1984. Lost profits in each year were taken to be awarded as of that year and then allowed to accumulate interest (though not at the risk-free after-tax rate, as we have suggested). Compared to the calculation given by Equations 22.3, 22.4 and 22.5, the plaintiff's result overstated the damage award by as much as 100 per cent![10]

Continuing violations

So far, we have consistently assumed that the violation involved is a one-time affair resulting in the destruction of an asset or, equivalently, the loss of an opportunity. Very often, however, violations are more complex than this. Damages can result from on-going violations, from a stream of acts lasting over time. We must now consider how our analysis should be adapted to deal with such cases.

Fortunately, this is easily done in principle, although practice may often prove more difficult. We can consider each violation as a new act and award damages and interest according to the principles already given. More precisely, we must deal with a whole set of but-for worlds: the world with no violation; the world with violations ending at time 1; at time 2; and so forth.

Adapting our previous notation, we assume that the violations began at time 0 and ended at time $s \leq t$. Let $\hat{G}(i, j)$ denote the after-tax profits that would have been earned at time i had there been no violations later than j ($\hat{G}(i, -1)$ denotes after-tax profits in the no-violation world.) Let r_j denote the risk-adjusted discount rate appropriate to after-tax cash flows from the plaintiff's projects as of time j and $\hat{r}_k^*$ denote the after-tax risk-free rate as of time k.

Each time period's violation brings with it (in principle) a continuing stream of lost profits. The undiscounted after-tax lost profits which occur in year i as a result of violations in year j are given by

$[\hat{G}(i, j-1) - \hat{G}(i, j)]$. In accordance with the previous analysis, such profits are to be discounted back to the time of violation at j using the risk-inclusive rate and then compounded forward to t using the risk-free rate. This makes the total amount of the damage award after taxes:

$$\hat{S} = \sum_{j=0}^{s} \sum_{i=j}^{\infty} \frac{[\hat{G}(i, j-1) - \hat{G}(i, j)]}{(1 + r_j)^{i-j}} \prod_{k=j+1}^{t} (1 + \hat{r}_k^*) \qquad (22.6)$$

The before-tax award is made by adjusting $\hat{S}$ to obtain S as in Equation 22.4 above.

Despite its complex appearance, this rule is really quite simple in principle. The change in the profit stream brought about by each violation is discounted back to the time of that violation and then compounded forward at the risk-free rate.

In practice, however, this is likely to be impractical. It is hard enough to estimate lost profits in a single but-for world. The task of doing so for s different but-for worlds differing by the date of assumed cessation of violations can easily be overwhelming.

There are several things to be said about this, however. First, the practical importance of making such estimates depends on the amount of carry-over effect that previous violations have on later profits. If cessation of violation would have returned the profit stream to that of the no-violation world in, say, m periods, then $\hat{G}(i, j-1) = \hat{G}(i, -1) = \hat{G}(i, j)$ for $j \leq i - m$. If m is small, then most of the terms in Equation 22.6 will be zero.

Note, in particular, that if cessation of violation would have instantly restored the no-violation profit stream ($m = 1$), then Equation 22.6 takes the much simpler form:

$$\hat{S} = \sum_{j=0}^{s} [\hat{G}(j, -1) - \hat{G}(j, j)] \prod_{k=j+1}^{t} (1 + \hat{r}_k^*) \qquad (22.7)$$

In this case, only one but-for world need be constructed – that in which no violations took place. Actual profits earned in year j are subtracted from the profits that would have been earned in that year in the no-violation world and the result brought forward from j to t by compounding at the risk-free rate.

It is also useful to note that the deviations from this relatively simple rule that occur in more complex cases are entirely due to discounting and compounding. If all the discount rates in Equation 22.6 were zero, then the terms corresponding to a given i would simply sum to $[\hat{G}(i, -1) - \hat{G}(i, s)]$, the difference between profits in the no-violation world and actual profits.

Accordingly, we recommend that in practice the simple rule given in Equation 22.7 be followed. If there are small carry-over effects of previous violations, then some adjustment for discounting should be made. For example, if some fraction, g, of lost profits in year $j + 1$ can reasonably be associated with violations ending in year j, then lost profits up to $s + 1$ should be adjusted by discounting that same fraction, g, of them for one year by the risk-including rate and compounding them forward for one more year at the risk-free rate. While g will seldom be knowable, it may be reasonable to place an upper bound on it. If the upper bound is small, the effects of the adjustment involved can be readily limited, particularly because effectively only the difference between the two discount rates matters.

Naturally, such a recommendation would not apply to cases in which a major violation occurred early and would have had long-lasting effects even had there been no further violations.

Using hindsight: Janis Joplin's yearbook

Most of the analysis so far given has begged an important question. How should one estimate the stream of lost profits to be discounted? In particular, should one use hindsight, estimating what *would* have happened had there been no violation, or should one instead use only such information as was available when the violation took place? Where there are few carry-over effects from a particular violation, this issue does not matter. Where carry-over effects are large and long-lasting, it can matter very much. Since, as discussed in the preceding section, on-going violations are likely best to be treated without much adjustment for carry-over effects, the hindsight problem is most likely to be important in practice in the case of a single violation destroying an asset.[11] We now return to that case.

We have already implicitly indicated our answer to the question at issue. In choosing a discount rate with which to calculate the present value of the stream of returns associated with the destroyed asset, we chose the plaintiff's opportunity cost of capital (or other rate associated with the riskiness of the stream) *as of the time of violation*. Similarly, we used the tax rate prevailing as of that time. (See Equation 22.5, above.) If hindsight were to be used to estimate the stream of returns, there would be no reason not also to use actual discount rates and tax rates as they developed over time.

As this suggests, our position is that hindsight should not be used.[12] Rather, the stream of returns should be estimated using the information available as of the time of violation. Indeed, as we shall see, expectations as of that time are particularly relevant.

There is, of course, no question but that had the plaintiff been made whole as of the time of violation, time 0, the destroyed asset would have been valued as of that time and the plaintiff paid accordingly. The question at issue only arises because this did not happen, and the plaintiff is to be made whole as of time t, a later date.

But we have already discussed this issue. The fact that the plaintiff is to be made whole as of t means that it must be recompensed for the time value of money. This means interest at the risk-free rate on the time 0 award. Why should it mean any adjustment in the award principle itself? The reason that one might be tempted to make such an adjustment is as follows. Had the plaintiff actually not been deprived of the destroyed asset, it would have experienced a particular stream of returns. Hence, if we can tell what that stream would have been, the plaintiff can best be made whole by giving it that stream with an appropriate adjustment for interest.

This argument is wrong. The violation did not merely deprive the plaintiff of the stream of returns that would have accompanied the asset. It also relieved the plaintiff of the uncertainty surrounding that stream. To use hindsight is to ignore the latter effect. As already explained, the way in which both effects can be taken into account is to value the asset as of the time of violation, taking account of uncertainty, and then award the time value of money making no allowance for uncertainty.

Some simple examples will illustrate what is involved. The first – and the one to which we shall return – is a somewhat simplified version of a hypothetical question posed to me in a deposition in the *ETSI* case.[13] The case was to be tried by a jury in Beaumont, Texas, adjacent to the town of Port Arthur.

Janis Joplin, the rock star, went to high school in Port Arthur, Texas. Suppose that when she graduated she signed one copy of her high-school yearbook. Suppose further that nobody had any idea that Ms Joplin would one day be famous. Assume that signed high-school yearbooks were being bought and sold for $5.00 in Port Arthur, regardless of whose signatures they contained.

Assume that a thief stole and destroyed the copy of the yearbook with Janis Joplin's signature. The legal proceedings that followed took considerable time, and, by the time a damage award is to be made, Janis Joplin is known to have been a star, with her autograph selling for $1,000. Ignoring punitive issues (and assuming that the yearbook has no sentimental value), what damage award will make the plaintiff (the book's owner) whole?

The temptation, of course, is to use hindsight and award $1,000. The other answer – $5.00 plus interest at the risk-free rate – seems somehow very unfair. That perception is incorrect, however, and the temptation ought to be resisted.

The book's owner was not deprived of a yearbook containing the autograph of a rock star. He or she was deprived of a yearbook plainly worth $5.00 that contained one or more signatures. Associated with that yearbook was uncertainty as to whether any of the autographs it contained would ever be worth anything. The $5.00 price of the yearbook included the value of the small probability that they would. It also included the value of the rather more likely outcome that they would not. A book equally valued by the owner at the time could have been purchased for $5.00, and the owner could have, in effect, mitigated the damage by purchasing a replacement and acquiring an essentially identical asset.

To put this another way, we extend the example somewhat. Suppose that yearbooks without Janis Joplin's signature are worth nothing by the time of the award. Suppose that the thief had stolen and destroyed another yearbook at the same time, a yearbook without Janis Joplin's signature. It is surely unfair for the second plaintiff to be awarded nothing at all while the first one gets $1,000. At the time they were stolen, both yearbooks were considered interchangeable by their owners. The owner of the Janis Joplin yearbook has been deprived of a chance at $1,000, but so has the owner of the other yearbook. Moreover, the owner of the Janis Joplin yearbook has been relieved of the chance of discovering that his or her yearbook turned out to be worthless.

The point may be illuminated further by using a different example.[14] Suppose that the asset destroyed was the opportunity to enter into a long-term contract thought at the time to be valuable. Suppose, however, that, with the benefit of hindsight, we now know that the contract would have been a disaster, losing money for the plaintiff. Surely, one would not assess negative damages, having the plaintiff pay the defendant.

The two cases are symmetric, however. The reader who finds it hard to accept our argument should attempt to enunciate a principle on which the use of hindsight leads to paying a high award when the asset turns out to have been unexpectedly valuable and does *not* lead to negative damages when the asset turns out to have been a loser.[15]

In fact, there is no such principle. In both cases, the plaintiff was deprived of a valuable asset. The mere passage of time does not change that fact. Further, hindsight does not change the value that the asset had when it was destroyed. Making the plaintiff whole today means making it whole as of the date of the violation plus compensation for the pure time value of money. Giving the plaintiff the lost profits that hindsight suggests does not place it in the position it would have occupied

without the violation; it replaces an uncertain world with a particular outcome.

Private information

This result, however, holds most plainly in the case in which the destroyed asset had a clear market value and could be replaced. In that case, one can say that the plaintiff could have mitigated the damage by replacing the asset. But suppose that the asset was not of the sort freely traded or, equivalently, that private information caused the plaintiff to place a different value on this particular asset than did the market.

To fix ideas, return to the example of Janis Joplin's yearbook. Suppose that the owner of the yearbook had information leading him or her – alone in Port Arthur – to believe it likely that Janis Joplin would someday be a star. In that case, the owner would have valued the Janis Joplin yearbook at the time of theft at more than $5.00, the price at which it could then have been sold. If that is so, then making the plaintiff whole as of the time of violation means an award as of that time of more than $5.00. It means an award as of that time of the amount for which the owner would have *sold* the book; in this case, that is greater than the price at which he or she could have bought it.

There are problems here that warrant discussion, however; they combine issues of principle with issues of practice.

Obviously, it will be to plaintiff's advantage to argue that it valued the destroyed asset especially highly. Here, the burden of proof that such valuation exceeded that which the market either did or reasonably would have placed on the asset belongs to the plaintiff. In the case of Janis Joplin's yearbook, for example, the plaintiff should have to show either contemporaneous private information or, at least, contemporaneous statements revealing that he or she thought Joplin had star potential.

Note that the extra valuation must rest on the peculiar properties of the destroyed asset. If the asset was replaceable in the plaintiff's eyes, then the replacement cost should be used. (As already remarked, replacement of the asset can be considered a form of mitigation.)

In this connection, it is a mistake to value the asset differently merely because of plaintiff's particular risk preferences. Suppose that the stream of returns reasonably expected to accompany the asset would have a rather low present value if discounted using an appropriate market evaluation of risk. Suppose that the plaintiff asserts that it was less risk-averse than the market, so that, in its eyes, that stream of returns was worth a higher value. By itself, this should make no difference. The plaintiff may not have been able to exercise its risk preferences with the destroyed asset, but there are many opportunities to invest in risky assets, paying only the price that the market would pay for risk. This is a different case from that in which private information or belief about the *particular* asset made the plaintiff value it above market price.

Naturally, the task of assessing the valuation actually put by the plaintiff on a destroyed asset will often be difficult when the asset is not identical to others. Proponents of a particular project within a firm will typically have put forward rosy forecasts about its profitability. Plaintiff will certainly produce those forecasts to show extra valuation. What matters, however, is the extent to which top management took (or would have taken) such forecasts seriously as a cause for action. The refusal of an offer for Janis Joplin's yearbook puts a believable lower bound on the value.

It is in assessing the reasonability of plaintiff's claimed valuations that hindsight can play some role. Under most circumstances, what actually happened is at least within the support of the probability distribution of expectations before the fact. A contemporaneous document of plaintiff coming reasonably close to forecasting what actually occurred is certainly to be taken seriously.

Notes

1. In what follows, we assume that injury begins when the violation occurs. If not, there is a question as to whether the plaintiff should be made whole as of the time of violation or as of the time of first injury. We ignore this. Our analysis can easily be adapted to either standard.
2. Many of the same issues are discussed in James M. Patell, Roman L. Weil, and Mark A. Wolfson (1982). Although we are in general agreement with the approach there taken, we differ in some particulars and consider some issues not there discussed.
3. Our views on the appropriate rate for pre-judgment interest have been informed by conversations with others, especially A. Lawrence Kolbe, who convinced us of the position here taken. We believe that position to have originated with Stewart Myers. Naturally, neither Myers nor Kolbe is responsible for our errors.
4. On this point we disagree with the conclusions reached in R. F. Lanzillotti and A. K. Esquibel (1990). The authors there argue that, if the destruction of the asset forces the plaintiff to borrow, then the plaintiff should be compensated by receiving interest at its borrowing rate. But the destruction of any asset forces even plaintiffs with deep pockets to borrow from themselves, as it were, bearing the opportunity cost of foregone earnings. There is thus no reason to distinguish borrowing and non-borrowing plaintiffs in this regard. Further, in the example given in the text, Ravenal will have a higher borrowing rate than Hetty. But, since that higher rate stems from causes having nothing to do with the violation, there is no reason why

Ravenal should be compensated at a higher rate than Hetty is.

5. If the defendant is not a corporation but an individual, the same argument would suggest using the defendant's borrowing rate.
6. The Internal Revenue Code provides for an exclusion from personal income taxes damages received on account of 'personal injuries or sickness'. For a discussion of Tax Court decisions on the interpretation of 'personal injuries or sickness', see David G. Jaeger (1989).
7. *ETSI Pipeline Project et al.* v. *Burlington Northern Inc., et al.*, Civil Action B-84-979-CA.
8. It is worthwhile to note that this is *not* typically the plaintiff's return on equity. The capital asset pricing model (CAPM) can be used to obtain the required return on equity and adjustment for debt structure can then be made. See, for example, Richard A. Brealey and Stewart C. Myers (1988).
9. The stream in Equation 22.5 is, in principle, extended to infinity to take account of the fact that the loss of profits resulting from the violation may extend for an indefinite time. Naturally, if it is believed that the cessation of the violation or other relief ends the loss of profits at some particular time, then the calculation can stop there too. To put it another way, the term M_t in Equation 22.5 represents the difference between profits in the 'but-for' world in which the violation never took place and profits (with losses suitably mitigated, if necessary) in the actual world. Those differences may in fact be zero after time t (or some earlier time), but they need not be so.
10. A particular feature of the plaintiff's case had the effect of exaggerating the difference between the two treatments. ETSI used different risk-adjusted discount rates for different years. Discounting for the years between 1988 and 1990 (during the construction period of the project) was at a relatively high rate, while a lower discount rate was applied for the years after 1990. This tended to exaggerate the effects of the error made in calculating the damage award, because ETSI's method implied that if the trial was delayed long enough the higher discount rate would never have been applied.
11. Note that in the case of an on-going violation, forgoing the use of hindsight does not mean valuing the entire stream of lost income from the standpoint of the start of the violation, rather it means valuing the effects of each year's violation from the standpoint of that year.
12. This is also the position taken by Patell *et al.* (1982).
13. *ESTI et al.* v. *Burlington Northern et al.* (1988). The examining attorney, Rufus W. Oliver III, was representing Houston Lighting and Power, whose interests would be served if hindsight was not used. Presumably, he chose this example to nail me firmly to the position taken in the text.
14. This example arguably applied to Houston Lighting and Power in the *ETSI* case.
15. While one might be content with a principle that leads to this result, such a principle must be avoided for the moral hazard it creates. That is, if a plaintiff always receives the benefit of an unexpectedly favorable turn of events but does not suffer the cost of an unexpectedly disastrous turn of events, then there is an incentive for potential plaintiffs to make violations easy, thereby reducing or eliminating their risks. Furthermore, plaintiffs would have an incentive to influence the timing of the trial in their favor. Patell *et al.* provide a discussion of this issue.

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EXHIBIT 10

Measuring Damages in Commercial Litigation: Present Value of Lost Opportunities

R.F. LANZILLOTTI* AND A.K. ESQUIBEL**

I. Introduction

The dramatic increase in commercial litigation in recent years has focused attention on the measurement of damages, if any, to be awarded to plaintiffs. A review of judgments awarded by the courts reveals a hodgepodge of approaches and theories on which awards have been rendered. A striking aspect of the judgments is their lack of consistency in applying basic principles of economics and finance.[1] This article sets forth a framework for determining the present value of a plaintiff's damage award. Additionally, the article identifies some indirect opportunity losses that a plaintiff may suffer because of a defendant's wrongful act.

II. Purpose and Timing of Damage Awards

A commercial lawsuit is essentially a claim by the plaintiff that "but for" the wrongful act of the defendant, plaintiff's business would have performed better than it actually did, that is, defendant's wrong caused plaintiff's business a loss in going-concern value. The going-concern value of a firm is the value of a firm as a profit-producing asset. Going-concern

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1. *See, e.g.*, Fishman v. Estate of Wirtz, 807 F.2d 520 (7th Cir. 1986). The plaintiff in this case was an unsuccessful bidder for a professional basketball franchise. The plaintiff sued the defendant, the successful bidder, for violations of Section 1 and 2 of the Sherman Antitrust Act. The opinion illustrates the extraordinary complexity of determining damages in commercial litigation. The opinion has a rigorous dissent by Judge Easterbrook on both the liability and the damages issues that grapples with the concept of lost opportunities. *Id.* at 563.

value normally is estimated by projecting profits for the business, then discounting this profit stream to a present value.

To redress the wrong and to make plaintiff whole, the plaintiff should receive as a damage award the amount of this loss in going-concern value.[2]

More precisely, in determining the amount of a plaintiff's damage award, the going-concern value must be calculated twice: (1) the first calculation considers the circumstances encountered by the plaintiff as a result of a violation; (2) the second calculation considers the circumstances the plaintiff would have encountered had there been no violation. The difference between these two valuations, illustrated in Figure 1, is the loss in going-concern value suffered by the plaintiff.[3]

The calculation of the plaintiff's damage award is fairly straightforward if the plaintiff's situation is as depicted in Figure 1, indicating that the violation, its detection, its adjudication and compensation all occurred at the same moment. In practice, it is virtually impossible for all of these events to occur simultaneously. The time that the plaintiff receives an award always lags the violation because of the time needed to detect a violation and to proceed with litigation. Figure 2 portrays more realistically the plaintiff's circumstances.

As can be seen from Figure 2, at t_1, the plaintiff's loss in going-concern value consists of harm suffered by the plaintiff in the past and harm he will suffer in the future. The graph also illustrates that the time of the award, t_{1*}, lags the violation, t_0. Because of these differing time periods, measuring the loss in going-concern value incorporates both present and future value calculations using different discount rates. The choice of a discounting method can make a considerable difference in a plaintiff's damages.[4]

2. The loss in going-concern value is essentially the reduction in the fair market value of a business due to wrongful conduct. In the legal literature, lost profits and going-concern are sometimes discussed as alternative, or conceptually distinct methods for damage calculation. In theory, these methods are not conceptually distinct and properly applied would yield the same result. *See, e.g.*, Joslyn, "Measures of Damages for the Destruction of a Business," *Brooklyn Law Review* 48, 431, 431–32 (1982)(plaintiff not allowed to recover for both loss in going-concern value and lost profits because such an award would be duplicative). For an example from the case law, *see* Albrecht v. Herald Co., 452 F.2d 124 (8th Cir. 1971).

3. The plaintiff may only recover for damages causally linked to the violation. The doctrine of antitrust injury requires that a plaintiff prove that the injury was the result of an anticompetitive effect. Therefore, the plaintiff must establish more than a violator's presence in the market. To ensure that the antitrust laws protect competition and not competitors, the plaintiff must establish that his injury flows from the anticompetitive acts, and not the legal or competitive acts, of the violator. Brunswick Corp. v. Pueblo Bowl-O-Mat, Inc., 429 U.S. 477, 489 (1977).

4. *See, e.g.*, Fishman v. Estate of Wirtz, *supra* footnote 1. The dissent points out that the difference between choosing the cost-of-capital adjusted for the risk of the project and the risk-free rate accounted for "more than the entire award of lost profits in th[e] case." *Id.* at 581.

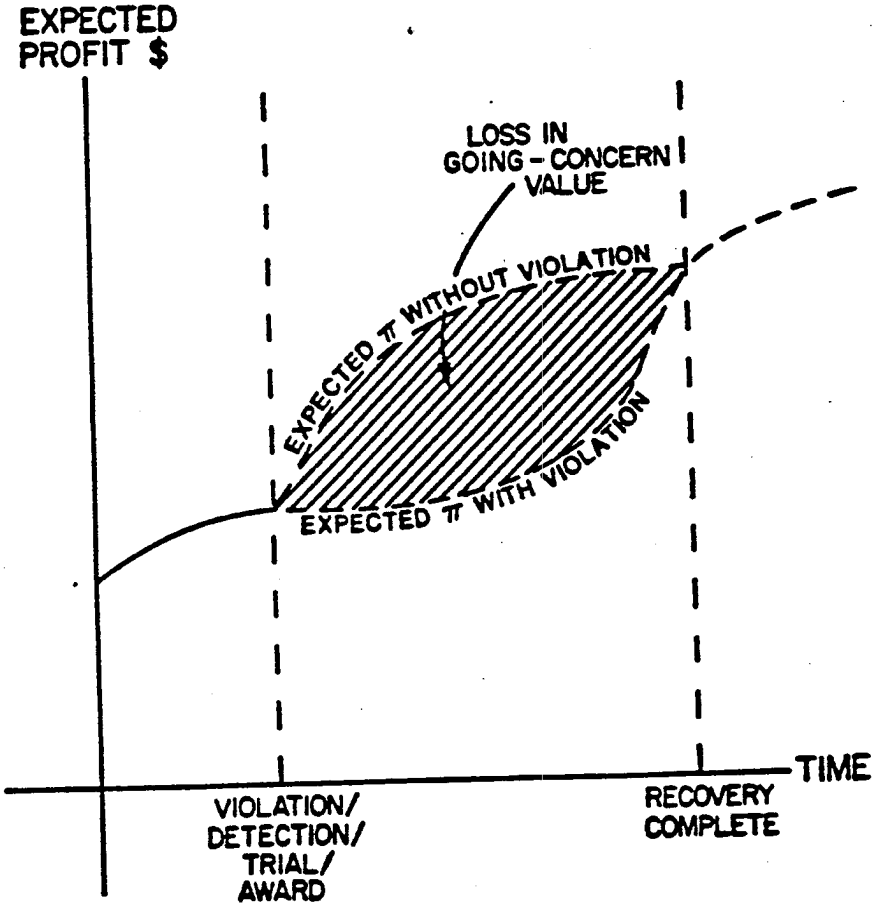
EXPECTED PROFIT $
LOSS IN GOING - CONCERN VALUE
EXPECTED π WITHOUT VIOLATION
EXPECTED π WITH VIOLATION
TIME
VIOLATION/ DETECTION/ TRIAL/ AWARD
RECOVERY COMPLETE

FIGURE 1

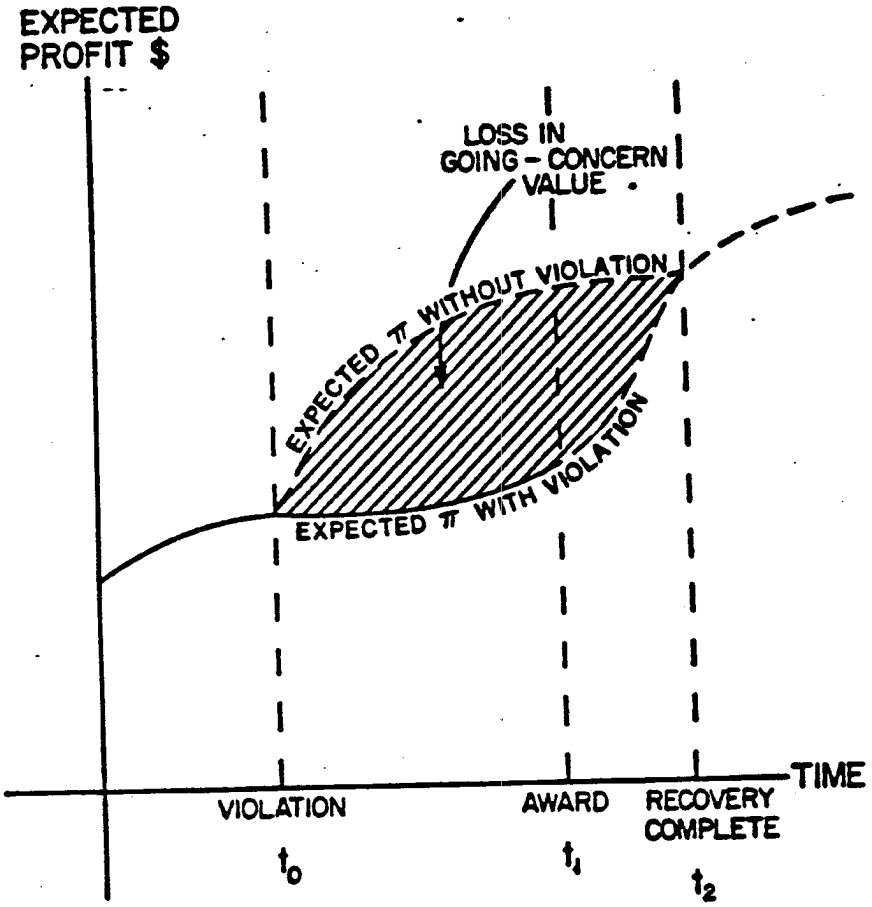

FIGURE 2

III.]

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III. Present Value of Plaintiff's Harm

In any commercial litigation, the plaintiff should receive the present value of the harm wrongfully inflicted.[5] If the plaintiff receives more than the present value, he has received a windfall and the defendant has to pay for harm he did not cause. Conversely, if plaintiff receives less than present value, he is not made whole and defendant escapes from fully paying for the harm he caused.[6] A simple case helps illustrate the framework for calculating a plaintiff's damage award. Assume that defendant infringes on plaintiff's patent-protected product. The plaintiff sues, and the court rules that defendant completely infringed upon plaintiff's patent.[7]

The damage award to plaintiff is the decrease in the plaintiff's going-concern value caused by the infringement. Because of the infringement, plaintiff has lost profits for past years. In addition to past losses, profits in future years will be lower than they would have been without the infringement. A damage award must compensate plaintiff for both past and future losses, but it must be made *in full at the present time*. Therefore, the past lost profits must be compounded forward to the present and the future lost profits must be discounted backward to the present.[8]

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5. Jones & Laughlin Steel Corporation v. Pfeifer, 462 U.S. 523 (1983). In this opinion, the United States Supreme Court endorsed the concept of present value, recognizing that "even in an inflation-free economy the award of damages to replace the lost stream of income cannot be computed simply by totaling up the sum of the periodic payments. For the damages award is paid in a lump sum at the conclusion of the litigation, and when it—or even a part of it—is invested, it will earn additional money." *Id.* at 536.

6. Either of these situations undermines both the compensation and deterrence goals of damage awards. If plaintiff's are under (or over) compensated or defendant's under (or over) deterred, potential litigants many make socially undesirable investments in litigation or litigation avoidance.

7. This hypothetical is based on a real case, Ambrit, Inc. v. Kraft, Inc., 805 F.2d 974 (11th Cir. 1986). The plaintiff, Isaly Co., Inc. (Isaly became Ambrit, Inc.) sued Kraft alleging trademark and trade dress infringement. At the time of the infringement, Isaly was a small ice cream manufacturer. The company, however, was rapidly growing because of the success of an ice cream novelty it developed. This novelty was a square, five-ounce, chocolate-covered ice cream bar that they trademarked a Klondike bar. Ironically, Isaly approached Kraft to distribute Klondike bars in Florida. This introduction proved a success. So much of one that Kraft, which was frustrated by continuing failure in the ice cream novelty market, decided to develop their own square, five-ounce, chocolate-covered stickless ice cream bar. Kraft called its bar Polar B'ar. Remarkably, a polar bear appeared on the Klondike wrapper. In fact, the names were essentially the only difference between the bars. The wrappings were so similar that customers consistently confused the two products. The appeals court affirmed the district court finding of trade dress infringement.

8. For an exposition of the fundamentals of the time value of money, *see* E. Brigham, *Financial Management: Theory and Practice*, Chapter 4, "Time Value of Money," 89–127 (4th ed., 1985, Dryden Press). For advanced study on financial theory and capital markets, *see* T. Copeland and J. Weston, *Financial Theory and Corporate Policy*. (3d ed., 1988, Addison-Wesley Publishing); H. Levy and M. Sarnat, *Portfolio and Investment Selection: Theory and Practice* (1984, Prentice-Hall International).

A. Future Lost Profits

Paradoxically, the uncertain future lost profits are the easiest to deal with. Figure 3 depicts the area of future lost profits. The arrow illustrates that these future lost profits must be reduced to present value at the time of the award. By making a damage award today for profits that have not yet been lost, a court gives a plaintiff lost profits without requiring that he bear the risk associated with the investment project. (For purposes of the following discussion, the patented product is considered the investment project.) However, because the plaintiff no longer has to bear the investment's risk, the plaintiff is not entitled to be compensated for risk factors. In short, the plaintiff's damage award should not include the amount of the risk premium (the excess of the present value of the profits discounting at the risk-free rate over discounting at the cost of capital adjusted to the risk of the project).[9] Since damages for future lost profits should not include the amount of the risk premium, the plaintiff's award should be calculated using the cost of capital adjusted to the risk of the project.

The following calculation is plaintiff's compensation for future lost profits:[10]

$$C_F = \sum_{i=1}^{N} \frac{\Delta E(\pi_i)}{(1 + k)^i}$$

where N = the number of years covered in the range t_1, t_2 (Figure 3), $\Delta E(\pi_i)$ = the expected profit without the infringement, less the expected profit with the infringement,[11] and k = the cost of capital adjusted to the risk of the project.

As previously discussed, k is used because the future profits, $\Delta\pi_i$, are uncertain, hence $\Delta E(\pi_i)$ is discounted by the appropriately risky discount rate. If r, the risk-free rate, were used, plaintiff would be overcompensated, that is, plaintiff would be in a better economic position than if the infringe-

EXPECT PROFIT

9. The frameworks developed in this paper are of general applicability. All that is necessary is identification of the investment project which could be anything from a single product to an entire market. Additionally, these frameworks apply irrespective of a plaintiff's legal theory. The issues of loss in going-concern value, present value, direct and indirect losses may arise in contract, tort or antitrust actions.

10. This paper presents a discrete model. The equation for the continuous model is:

$$C_F = \int_{t_1}^{t_2} \Delta E(\pi_i)\, e^{-kt}$$

11. $\Delta E(\pi_i) = 0$ when recovery is complete.

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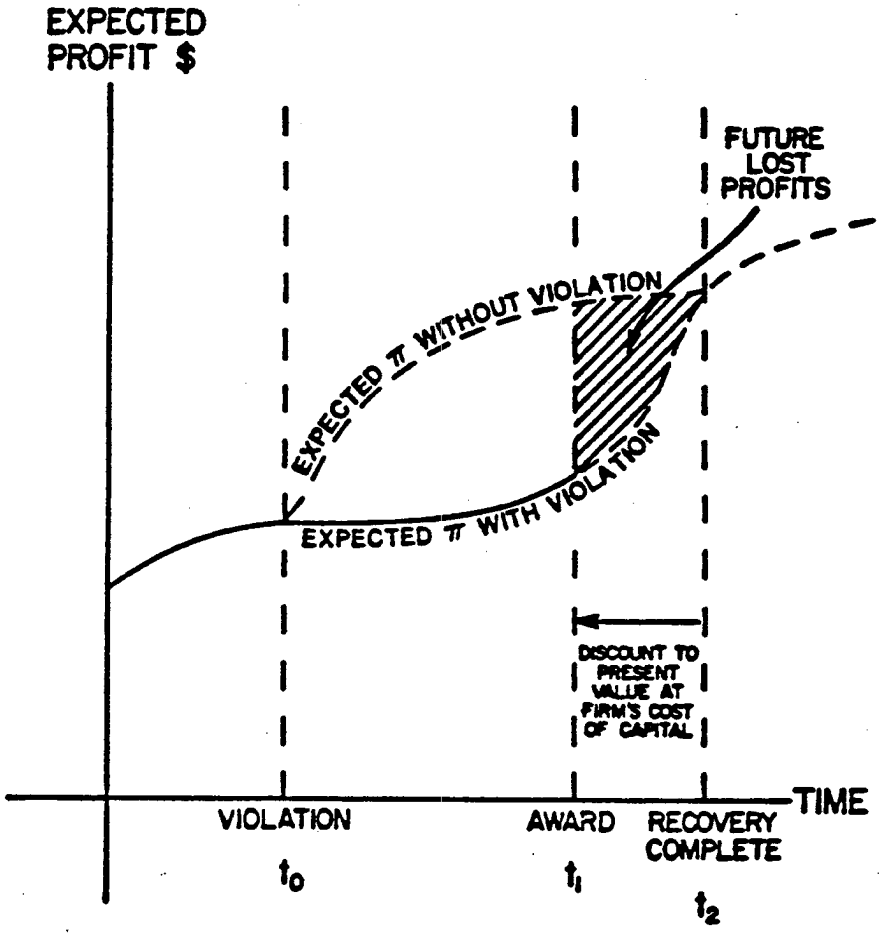

FIGURE 3

TABLE 1

	Cost of Capital			
	5%	10%	15%	20%
Damage Award (C_F) for Future Lost Profits	$45,441	$39,460	$34,662	$30,757

ment had never occurred; plaintiff would have the risk premium profits from an investment for which he never had to bear the risk.

The choice of discount rates can make a substantial difference in a damage award. To illustrate the difference assume that after the time of the award, $\Delta E(\pi_i)$ is $10,000 per year for five years, $1,000 per year for three years and $10 per year for two years. After ten years, plaintiff has recovered from the violation. Table 1 shows the sensitivity of the damage award to various costs of capital and the importance of careful estimations.

In summary, the plaintiff's damage award for profits to be lost after the award is made, future lost profits, is the present value of the future profits discounted to the time of the award by the cost of capital adjusted to the risk of the project.

B. Past Lost Profits

If the plaintiff's situation was as illustrated in Figure 1, the above damage calculation would constitute the total amount of the plaintiff's compensation. As discussed before, however, the situation is more like Figure 2. The plaintiff's damage award, therefore, has two components, *past* lost profits and *future* lost profits. Figure 4 illustrates.

The determination of the plaintiff's award for *past* lost profits is a little more difficult and controversial than for *future* lost profits. Two approaches exist for calculating the past lost profits component.[12]

Approach A. This approach relies on the distinction between past lost profits and future lost profits that the former are certain in amount because they have materialized, while the latter, being future events, are uncertain in amount. This certainty/uncertainty distinction is the basis for choosing between interest rates. Since the future lost profits are uncertain, the cost of capital adjusted to the risk of the project is used to discount to the time

12. For further discussion of the relative merits of the following approaches, please see Franklin Fisher's comments published *infra*.

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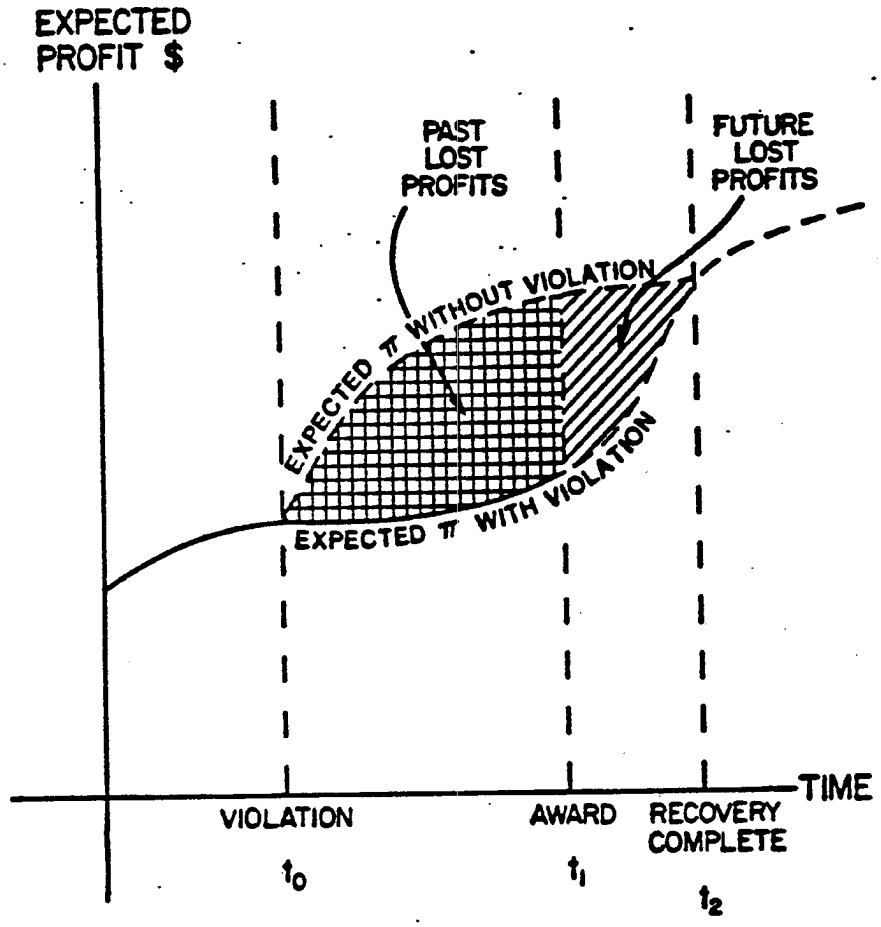

FIGURE 4

of the award. In the case of past lost profits, the expected profits lost can be best estimated by the materialized cash flows, and since the materialized cash flows are certain, the risk-free rate should be used to bring the past lost profits to present value.

Calculation of plaintiff's compensation for past lost profits is:

$$C_p = \sum_{i=1}^{N} \Delta\pi_i (1+r)^{N-i}$$

where $\Delta\pi_i$ = the profits lost before the time of the award, t_i, because of the infringement, and r = the risk-free rate.

As previously discussed, r is used to bring *certain* past lost profits to the time of the award, t_i. Assume plaintiff has lost $10,000 in profit in each of the past three years before the award due to the violation. Assume that the risk-free rate is 5 percent. Applying the above equation, plaintiff's compensation for past lost profits is $33,101.

Approach B. This approach is conceptually different from Approach A which compounded past lost profits, evidenced by the materialized lost cash flows, forward to the time of the award using the risk-free rate. For comparative purposes, Approach A along with the appropriate interest rate is represented by the time line in Figure 5. In contrast, the concept behind Approach B along with the appropriate interest rates is illustrated by the time line in Figure 6.

Approach B involves both a present value calculation (using the cost of capital adjusted to the risk of the project) and a future value calculation (using the risk-free rate). The basic idea is that the *expected* lost profits between the time of the infringement and the time of the award are discounted back to the time of the infringement. This discounting utilizes the cost of capital adjusted to the risk of the project (k). Next, the sum of the discounted expected lost profits is compounded forward to the time of the award using the risk-free rate (r).

Plaintiff's compensation for past lost profits under Approach B is determined as follows:

$$1.\ PV_{\text{infringement}} = \sum_{i=1}^{N} \frac{\Delta E(\pi_i)}{(1+k)^i}$$

$$2.\ C_p = PV_{\text{infringement}} (1+r)^{N-i}$$

Assume plaintiff has lost $10,000 in profit in each of the past three years before the award because of the violation. Assume that plaintiff's cost of capital is 15 percent and the risk-free rate is 5 percent. Applying the

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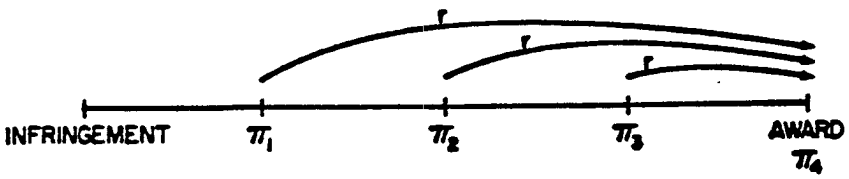

FIGURE 5

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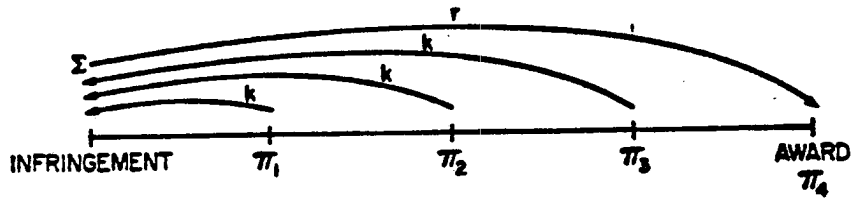

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above equations, plaintiff's compensation for past lost profits should be $27,753.

IV. Comparative Merits of the Alternative Approaches

Both Approaches A and B have merits, as well as vulnerabilities to challenge. While Approach B is *theoretically* more appealing, Approach A has practical advantages. Indisputably, the plaintiff should be compensated so that his going-concern value will be as if the defendant had not acted wrongfully. Assuming the same losses given previously, a comparison of the amount of compensation under Approach A and B shows a difference of $5,348. Hence, the two approaches can produce substantially different results. The difference of $5,348 represents the range of argument for the plaintiff and the defendant. If the defendant had not infringed, the cash flows from the plaintiff's project for the years covered by the period t_0, t_i is simply

$$\sum_{i=1}^{N} \frac{E(\pi_i)}{(1+k)^i}$$

where $E(\pi_i)$ = the expected profits from the project, in this case the patented product.

In other words, if the firm sold these expected profits at time t_0, to another firm, this is the amount of money that would be realized. Thus, PV_{inf} is the price or value of these expected profits at t_0. This amount must be compounded forward to t_i at the risk-free interest rate. Advocates of Approach B would argue that plaintiff's compensation should equal this "price" and that therefore $\Delta E(\pi_i)$ and not the actual $\Delta\pi_i$ are the relevant cash flows. Advocates of Approach A would argue that ignoring actual cash flows in favor of expected ones does not give proper weight to practical considerations.

To understand this claim, assume that for the first year the plaintiff estimates that he would realize $E(\pi_i)$ = $100. However, the actual realized cash flows by the defendant using the "stolen" product was π_i = $200. Assume the difference of $100 between π_i = $200 and $E(\pi_i)$ = $100 is the synergism of the efficient management of the defendant's company and the project profile of the patented product. Which figure is relevant? The plaintiff would like to claim the $200, but the plaintiff (a) does not have such an efficient management and (b) on average could not make more than $100 from the project. Hence, there is no justification for awarding the plaintiff the extra $100.

On the other hand, the defendant is realizing $200 due to the infringe-

ment, and if he pays damages of only $100, he retains $100 he would not have realized but for his wrongful act. The proper division of this extra $100 is not a simple question for economics, finance, or the law. Following strict economic and financial logic, plaintiff is not entitled to more than $100 in damages, and defendant is not entitled to the extra $100.[13]

Advocates of Approach A would argue that in a real-life situation plaintiff's tendency is to claim as damages $E(\pi_i)$, which may be unrealistically large figures. The judge and jury will observe, of course, the actual materialized values π_i. Since proving expected profits is very difficult, it is improbable that the judge or jury will ignore the materialized values π_i. Instead, to avoid speculation, the judge or jury may consider the realized certain values the best evidence and use that as the basis for the award. If the court bases the damage award on realized certain values, the risk-free rate should be used as Approach A advocates.

The distinguishing feature between Approach A and B is the estimation each makes of the expected profits at the time of the violation. Approach B relies heavily on the premise that expected profits not only drive investment decisions but are precise estimates of an investment's risk and return. Approach B carefully follows financial theory and calculates the expected profits at the time of the violation, arguing also that any information that becomes available subsequent to the violation is irrelevant. Approach B, therefore, ignores historical information.

Approach A emphasizes that expected profits are merely estimates or projections. Erroneous estimates by investors and businessmen are commonplace. Therefore, Approach A takes the position that it is advantageous to incorporate as much historical data as are available. Historical data are a better predictor than the expectations of businessmen. This approach also is in line with the predisposition of courts to look at the historical performance of a business in making damage awards.[14]

Finally, it is important to note that the full amount of the plaintiff's compensation is not only the amount calculated under Approach A or B for past lost profits, but also the amount of future lost profits calculated in the uncontroverted example.[15] Additionally, a plaintiff may suffer some indirect opportunity losses that go beyond the lost profits on the patented product.

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13. An argument can be made that the defendant should pay this extra $100, but not to the plaintiff. To preserve the deterrent effect and prevent a windfall to the plaintiff, the defendant might be required to pay the $100 to the state.

14. *See* R. Dunn, *Recovery of Damages for Lost Profits* (1978), 140. "Perhaps the best evidence of loss of profits is a comparison of the experience of plaintiff's own business before and after the interruption of its progress by the wrongful act of the defendant." *Id.*

15. An award of the present value of future lost profits and past lost profits should restore the

V. Indirect Opportunity Losses

Thus far, this paper has considered the plaintiff's *direct* losses due to the defendant's wrongful act. There are, however, also *indirect* losses. Assume that because of the infringement the plaintiff's cash flows suffered and subsequently the plaintiff was a net borrower for the period between the infringement and the award. If plaintiff had not suffered from the violation, he could have avoided borrowing. In this case, the compensation for past lost profits should be larger. Therefore, instead of using the risk-free rate, r, the future value calculation should employ the plaintiff's borrowing rate, r_b:

$$C_P = \sum_{i=1}^{N} \Delta\pi_i (1+r_b)^{N-i}$$

where N = the number of years included in the interval t_0, t_1.[16]

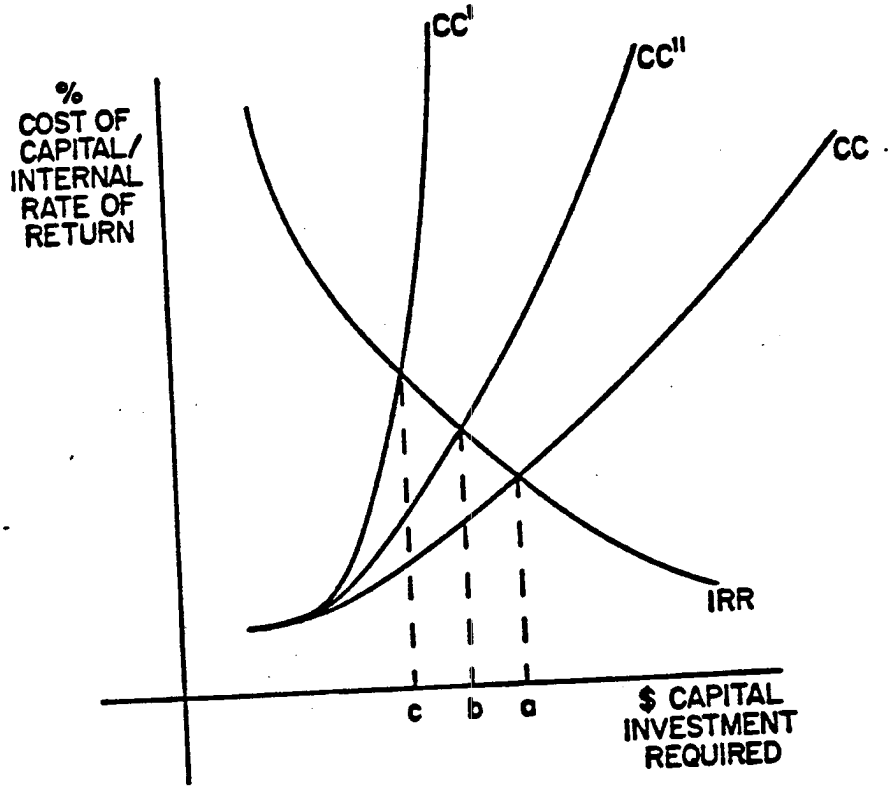
In addition, the infringement may have caused another element of harm. If the equity value of the plaintiff's business declined, plaintiff either may have paid a higher than "normal" rate on its borrowing, or was unable to borrow. Hence, plaintiff may have forgone some expected-to-be profitable projects. The infringement may also have impaired plaintiff's ability to raise equity; less stock can be sold or can only be sold at a lower price. The result of this impaired capital-raising ability is that the plaintiff had less capital available for investment during the period from the violation to the award. The effect is illustrated in Figure 7.

In the absence of the violation, plaintiff would have taken all projects up to "a," all of which would have a positive net present value because the firm's cost of capital is less than the project's internal rate of return.[17] The infringement may limit a plaintiff to only taking projects up to "b" or, perhaps, "c" if the firm had more serious cash flow problems and was foreclosed from the capital market. If because of the infringement, a plaintiff's cost of capital went from CC to CC', the plaintiff may be forced to forgo all projects between "c" and "a," and therefore, should receive as compensation, the net present value of all the projects between those two

plaintiff's direct losses. To fully compensate the plaintiff for the direct losses, however, may require one more calculation if the time of *payment* of the award, t_n, is not until sometime after the award time, t_1. All that is required is a future value calculation at the risk-free rate to compound.

16. If one uses Approach A, the plaintiff's borrowing rate is merely substituted for the risk-free rate in the equation. If one uses Approach B, the first equation remains the same but the plaintiff's borrowing rate is substituted for the risk-free rate in the second equation.

17. The internal rate of return is the discount rate that equates the present value of a project's expected cash inflows to the present value of the project's expected cash outflows.



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points. The same would be true to a lesser extent if the infringement put the plaintiff's cost of capital on CC" and caused plaintiff to forgo all projects between "b" and "a."[18]

Compensation for these projects that are indirect opportunity losses may be justified, even though they are difficult to measure. Indirect opportunity losses may be awarded if the plaintiff can produce convincing evidence that these indirect losses were caused by the defendant's wrongful act. In other words, the plaintiff must show that but for the defendant's wrongful act, the plaintiff would have seized these opportunities to grow.[19]

A multi-year business plan is an example of the type of evidence that would support a damage claim incorporating these indirect opportunity losses. In a case where a claim is to be made for forgone opportunities, the damage claim should track all managerial decisions in the business plan including asset acquisitions, divestitures, and financial restructuring.

/cc

VI. Conclusion

The foregoing analysis provides a rigorous economic and financial framework to determine the present value of a plaintiff's damage award. Every time a court makes a damage award, the present value of that award is a valid issue. Although the notion of present value is generally accepted by the judiciary, the method is not always properly employed. This analysis disclosed that reasoned applications of financial and economic theory may produce different, yet defensible, results. This paper concludes that where a choice of methodology exists, it does not necessarily follow that the more theoretically "elegant" approach is the most appropriate in light of practical considerations.

Furthermore, the discussion revealed that making a plaintiff whole by a damage award may demand consideration of indirect losses such as constrained capital-raising ability that results in forgone investment. Such indirect losses may be challenged as too remote or speculative for a court to

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18. Even if the cost of capital function were unaffected, a firm with a negative cash flow might not undertake a risky project even if it has a positive net present value. This might happen where there was not a perfect identity of interests between the corporation and the management. Due to agency costs (such as compensation systems), the managers may have incentives not to pursue profit maximization for the firm.

19. *See* Story Parchment Co. v. Paterson Parchment Paper Co., 282 U.S. 555 (1931). The United States Supreme Court in *Story Parchment* addressed the issue of uncertainty in damage awards. The Court acknowledged the difficulty of ascertaining the extent of damage in an antitrust case and stated that the plaintiff bore the burden of establishing the *fact* of damage with certainty but that did not extend to proving the *amount* of damage. Because the defendant's wrongful act caused the necessity of measuring the damages and the associated uncertainty, the defendant, and not the plaintiff, should, as a matter of public policy, bear the risk of the uncertainty. *Id.* at 561–65.

award. The framework for indirect losses, however, demonstrated that these losses are legitimate concerns, and suggests that claims for indirect losses should not be dismissed outright. Instead, courts should consider the evidence.

Courts have a more demanding and sophisticated task than choosing between the plaintiff's and defendant's damage calculation. Legal damage rules must be fortified by economic and financial theory. Hence, it is important that courts appreciate the theoretical and practical nuances of a damage calculation to make critical evaluations. Frameworks, such as those presented in this paper, can provide courts with a better understanding of the theory and mechanics of a damage award. Only with this understanding will courts be able to properly weigh the equities and produce a rational body of precedent.

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Measuring Damages in Commercial Litigation: Present Value of Lost Opportunities

PROFESSIONAL ADAPTATION

In commercial litigation, accurate determination of a plaintiff's damages requires the application of economic and financial theory. A weak theoretical foundation increases the likelihood that a damage award will not reflect the harm wrongfully inflicted on a plaintiff. As litigation increases in complexity and magnitude, a proper theoretical foundation becomes increasingly important. Although each case is unique, the law looks to economic and financial theory to provide guiding principles. To establish a framework for determining damages in commercial litigation, some common issues must be identified and a systematic way to resolve these issues must be developed.

In commercial litigation, the plaintiff firm generally is suing to recover a loss in going-concern value or lost profits. In other words, a damage award should restore the plaintiff to the profit position plaintiff would have realized but for the defendant's wrongful act. Going-concern value is a stream of profits. The defendant's wrongful act disrupts the flow of this stream, and the repercussions of this disruption continue into the future. By the time a plaintiff actually litigates a suit, the plaintiff already has suffered harm which he expects to continue into the future. Therefore, the plaintiff usually sues to recover both past lost profits and future lost profits. Because of the differing time periods involved, a plaintiff's damage award should be adjusted for the time value of money. Hence, in nearly every commercial lawsuit, a relevant issue is the present value of the plaintiff's damage award. Incorporating some practical aspects of the legal system, the present value framework presented in this paper considers the appropriate discounting and compounding methods with their corresponding interest rates; it also incorporates some practical aspects of the legal system.

In addition to these direct losses, the paper also considers the propriety of redressing indirect losses to the plaintiff. Although these losses may be susceptible to the argument that they are too speculative or too remote as a basis for a damage award, they may reflect real losses that should be recognized despite the problems of proof, for example, impaired cash flows that necessitate borrowing at a rate higher than the risk-free rate and in-

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